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RECORDS OF VIRUS DISEASES OF PLANTS IN PUERTO RICO

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These records are published at this time for the use of those workers who may be interested in the subject. Although the data is not complete it is made available for those who may want to use it.

AMARILIDACEAE

Eucharis grandiflora Planch (*E. Amazonica* Linstl.) This species is attacked by a mosaic which was reported by the writer in 1931. Up to the present time the writer has not found an individual of this species that did not show the disease. This disease is mentioned in the literature but the writer has not been able to find the first record. Bremer reported a stripe disease in 1926 which may be the same.

BIXACEAE

Maximiliana vitifolia (Willd) Krug & Urban. This is an introduced plant which has developed very pronounced mosaic patterns ranging through shades of green and yellow. It has been transmitted by budding. First published record.

BROMELIACEAE

Ananas ananas (L) Cockerell. The yellow spot and wilt diseases have been introduced from Hawaii on two shipments of slips of the smooth Cayenne variety, one in 1923 and the other in 1931. Both shipments were kept under observation for about two years and appeared to be perfectly healthy. In 1934 the yellow spot and wilt diseases (which are well known in Hawaii) were found in both plantings and they were placed under quarantine. These diseases corresponded to the descriptions of the diseases in Hawaii and have been controlled by controlling the ants.

A very similar symptom has appeared on the Cabezona pineapples in the vicinity of Lajas. This diseased condition has been known for several years and this variety has been degenerating, but the writer and others who have visited that region have failed to determine the cause of the trouble. Recent studies by the writer indicate that the disease is similar to yellow spot and wilt diseases of Hawaii but that the symptoms are not exactly the same. The writer plans to continue his studies on this disease.

The writer also found the spike disease in the Cabezonas recently. This disease was reported from Puerto Rico a number of years ago but has not been found during the past thirteen years that the writer has been on the Island.

COMPOSITAE

Bidens cynapiifolia H. B. K. This plant is subject to severe attacks of mosaic. In its mild form the disease produces a pattern which may be described as more or less blotchy in character. In the severe forms the leaves are more or less deformed.

CUCURBITACEAE

Cucumis sativus L. The mosaic disease was very severe during growing (winter) season of 1935–36. Many fields in the eastern part of the Island showed an infection of 100 percent. This is the first severe outbreak of this disease that has come to the attention of the writer during past thirteen years of residence on the Island. During that time the writer was never able to find more than one or two diseased plants in any planting.

DIOSCORIACEAE

Dioscorea sp. (cultivated variety). Some plants have been found showing well defined mosaic patterns and others that were uniformly chlorotic. The exact nature of this disease has not been determined.

EUPHORBIACEAE

Adenoropium gossypifolium L. A mosaic disease was reported by the writer in 1931. Recent studies indicate that it is not transmitted by the seeds but it is very easily transmitted by budding.

GRAMINEAE

Zea mays L. The writer has found a stripe disease of corn which appears to be the same as the stripe diseases reported by

Britton Jones (1923) in Trinidad and by Stahl (1927) in Cuba. This disease is characterized by cholorotic stripes following the veins of the leaves. These stripes are very narrow. The stripe symptoms appear on the upper 4 or 5 or 6 leaves only. In the first generation, some of the plants will be barren. In the second generation many seeds will not germinate, many plants will be dwarfed and barren, the larger plants will show the stripe symptoms and some of them will be barren. In the third generation these symptoms will be intensified and very few plants will produce grain. The disease is transmitted in the seeds.

LEGUMINOSEAE

Bradburya virginiana L. Kuntz. This species is subject to a well defined mosaic which is probably the same as the common bean mosaic. The experiments made by the writer indicate that it is not transmitted by seeds but *Aphis rumicis* is the probable vector.

Crotalaria anagyroides H. B. K. This species is subject to a mosaic which appears to be the same as the one on *C. striata* which was reported by the writer in 1931. Tests indicate that it is not transmitted in the seeds.

Crotalaria usaramoensis E. Baker. This species is subject to a mosaic which appears to be the same as the one on *C. striata* which was reported by the writer in 1931. Tests indicate that it is not transmitted by in the seeds.

Phaseolus lunatus L. This species is attacked by a virus which is probably the same as the common bean mosaic. Tests thus far indicate that it is not transmitted by the seeds. The writer suspects that *Aphis rumicis* may be the vector but we do not have any experimental proof.

MALVACEAE

Althae rosea (L.) Cav. This species is affected with a mosaic which was reported by the writer in 1935. Tests up to the present time indicate that the disease is not transmitted by the seeds but by an unknown insect vector.

MUSACEAE

Musa sp. The writers attention has been called to a mosaic disease of banana. This disease has been reported from other parts of the world. It is very rare in Puerto Rico.

Musa sp. A virus disease or virus-like disease is very abundant on the "enano" plantain in Puerto Rico. This disease appears to be very different from the bunchy top disease of the Far East and

does not correspond to the descriptions of diseases recently reported from Florida and Trinidad. Thus far it has been found on but one variety.

The spirals of diseased plants do not unroll properly. Sometimes they are bent to form hooks. Parts of the outer leaf may become dead, brown and torn by the growth of the inner parts. When the leaves of the spiral are first unrolled, they are chlorotic and crinkled and in severe cases become brown and die.

PASSIFLORACEAE

Passiflora laurifolia L. This is a very severe but rare chlorotic disease. The leaves are underveloped in size and irregular in shape. The writer has not demonstrated that this disease is due to virus.

STERCULIACEAE

Helicteres jamaicensis Jacq. A very pronounced case of a mosaic on this species was brought to the writer June, 1936, by Mr. W. A. McCubbin. Although we have no experimental proof that this is a virus disease the symptoms are so characteristic that it should be included in these records.

PHLOEM NECROSIS IN THE STRIPE DISEASE OF CORN

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Phloem necrosis has been reported for a number of plants infected with virus diseases, especially potatoes, tomatoes and beets, and may occur in many other plants infected with virus diseases. It is possible that it may be a diagnostic symptom in some types of virus diseases. However, this symptom must be studied in a much larger number of host plants and with a much larger number of viruses before its value in diagnosis and classification can be determined with certainty. We should also have a more complete knowledge of its appearance in plants with diseases due to other causes.

Gilbert (**9**) in a paper on correlation of foliage degeneration diseases of the Irish potato with variations of the tuber and sprout said—"Net-necrosis, of the phloem-necrosis type, is correlated in the tubers with a spindliness of sprout and seems to be a consistent symptom of leaf-roll. The necrosis symptoms are not persistent in the progeny tubers". A few years later (**10**) he reported that he had demonstrations of direct relation between leaf-roll and net necrosis. Quanjer (**12**) who has probably made a more extensive study of phloem-necrosis than any other worker on this subject made an attempt to classify and name potato viruses on the basis of the necrosis characters. Various forms of necrosis produced by several viruses in several species of plants have been studied by many workers during the past quarter of a century. It is a fruitful field of research for both plant histology and plant physiology.

November 17th, 1934, the attention of the writer was called to an outbreak of a white stripe disease of corn growing in a garden on the Agricultural Experiment Station farm. The symptoms of the disease corresponded with the descriptions by Stahl in Cuba (**13**) and Britton Jones (**1**) in Trinidad.

Some of the plants were very much dwarfed and did not produce ears. Others were full sized, some of them producing ears and others barren. The tendency to sterility was very pronounced. So many of the plants were sterile that it was difficult to find an ear satisfactory for seed. A plant in which the symptoms were fairly

good was selected and cross-polinated from a plant in which symptoms were very pronounced. Chlorosis of the upper leaves was characteristic in all cases and the pattern was that of stripes which followed the veins of the leaves. In some cases a single white vein ran through a dense green leaf. In other cases the leaf was almost white.

Four plants were selected and pieces of the leaves fixed for sectioning. These pieces were sectioned and stained for study.

Phloem necrosis was found in every case ranging from a very slight to a very pronounced necrosis (figures 1 to 5). In some few cases a similar condition was found in the parenchyma (figures 7, 8, 9, 10, 11). In the most severe cases there was a complete breakdown (figure 6) of many cells. In some cases there was an increase in the number of fibrous cells next to the epidermis and a thickening of the walls of these cells. The phloem necrosis was acompanied by a thickening of the walls of the epidermis cells, the fibrous cells and sheath (figures 1 to 5 and 12, 13). In some cases these cells developed thick walls, although there was no phloem necrosis (figure 12). Esau (1934) in a paper on curly-top of sugar beet reported "a collapsed parenchyma that had undergone degeneration and necrosis".

In the most extreme cases the part of the leaf in which the stripe was located was very thin (figure 12), but this was not necessarily accompanied by phloem-necrosis.

The effect on the cell contents was very noticeable. The chloroplasts in the sheath cells of the bundles with necrosis and the parenchyma cells around such bundles were few in number (figure 14) while the corresponding cells in a section from a healthy plant showed a large number of chloroplasts (figures 15, 16). The chloroplasts in the cells in healthy plants where somewhat larger in size than those in cells from chlorotic regions of diseased plants. There was no evidence of disintegration but abundant evidence of inhibition. This is in harmony with the work of the writer on mosaic diseases of sugar cane and other plants (**3**, **4**, **5**). In this connection it should be noted that Esau reported disintegration in two papers on curly top of sugar beet (**6**, **7**).

The nuclei in severely infected regions showed evidence of disintegration. Esau (**7**) reported hypertrophy of the nuclei in sugar beets infected with curly top.

Intracellular bodies were not seen.

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EXPLANATION OF PLATES

Figure 1.—Cross section of a leaf showing necrosis just above the lower epidermis.

Figure 2.—Cross section of leaf showing very slight necrosis.

Figure 3.—Another section showing same condition, but more pronounced.

Figure 4.—A section showing same conditions accompanied by a pronounced thickening of the epidermis.

Figure 5. A section showing necrosis and thickening of walls in the epidermis.

Figure 6.—A severe case in which there is a breaking down of cells in the fibro-vascular bundle.

Figure 7.—Necrosis and thickening cell walls in the parenchyma.

Figure 8.—Necrosis in the parenchyma adjacent to the sheath cells of the fibro-vascular bundle.

Figure 9.—A more pronounced case of necrosis in the parenchyma cells.

Figure 10.—A very pronounced case of necrosis next to the epidermis.

Figure 11.—A very pronounced necrosis surrounding a very small fibro-vascular bundle.

Figure 12.—A very pronounced thickening of cells of the epidermis. Note that the leaf is very thin in one place.

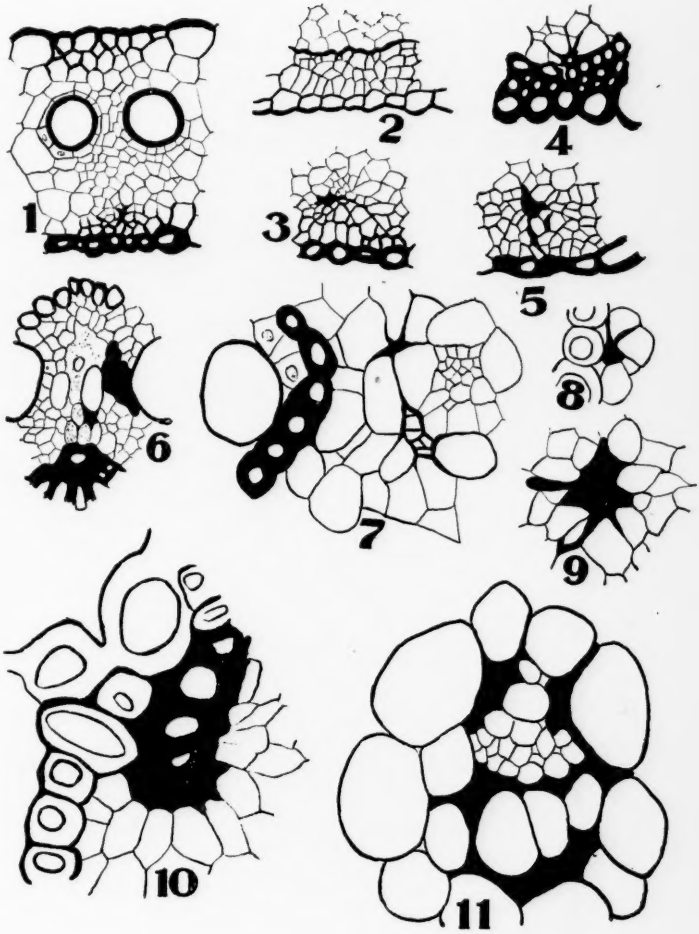
Figure 13.—Thickening of the walls of the epidermis and adjoining cells. Also the walls of the sheath cells surrounding a fibro-vascular bundle.

Figure 14.—Sheath cells and adjoining cells of a severely infected plant. Note that the chloroplasts are very few and very small.

Figure 15.—The same from a slightly infected plant.

Figure 16.—The same from a healthy plant.

PLATE I



DESCRIPTIONS OF VIRUS DISEASES OF PLANTS: CRITICISMS AND SUGGESTIONS

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The work of the writer on the index of host plants of virus diseases and on the index of insect vectors of virus diseases of plants has brought to light a considerable number of incomplete and in some cases incorrect records in connection with virus diseases of plants. Most of these records were satisfactory at the time they were made but the lapse of time and the increase in the literature makes some of these early records rather obscure or indefinite. It is very doubtful if some of these records could have been made more definite or complete at the time the papers were writen but there is no reason for our continuing to make similar errors in the future.

Tobacco mosaic was a satisfactory term until we found that there were several mosaic diseases of tobacco. It then became necessary to use a qualifying word such as "yellow mosaic", "interveinal mosaic", "aucuba mosaic", etc., and tobacco mosaic became "common tobacco mosaic". Our records would be much more satisfactory and much less likely to be misinterpreted in the future if the writers would insert qualifying terms before the names, even though it is a case of first virus disease reported on that particular host. Certainly the term "new virus disease" is unsatisfactory in all cases.

Records of new virus diseases of plants without definite names, numbers or letters and without descriptions of symptoms are not satisfactory and are likely to lead to confusion in the future. The term "new virus" is not satisfactory either now or in the future. A "new virus disease" today is an old virus disease tomorrow and another worker may present another "new virus disease" at any time in the future.

The use of the generic name of the host plant without the specific name is unsatisfactory. It is usually possible to secure the specific names except in the cases of cultivated varieties. In these cases the scientific name of the host from which the variety was derived should be given if possible.

When common names of host plants are used, the scientific names should be inserted in the titles, introductions or in parenthesis fol-

lowing the common name. The peanut of most parts of the United States is "gruber" in some parts of the country and in many parts of the world it is "ground nut", but it is *Arachis hypogea* in all parts of the world. Common names of host plants should rarely, if ever, be used unless accompanied by the scientific names.

The same rule applies to the use of common names of insect vectors. The writer has found a considerable amount of confusion arising from the use of common names of insect vectors. The use of the terms "leaf hoppers" or "aphis" may mean very little without explanation in any part of the world except the locality in which it was writen. The writer has found that it is sometimes difficult to know whether two writers were referring to the same or two different insects. Common names of host plants and insect vectors may be satisfactory at the time and in the country in which a paper is writen but may be very unsatisfactory in the future and in other parts of the world.

Reprints should always carry the name of the publication in which they appeared and dates of publication. The paging should be the same as in the original publication.